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ABSTRACT

Of necessity, adult educators will be turning to technological delivery forms to meet the insistent call for increasing numbers of programs. As teleconferencing, television, microwave, minicomputer, satellite, fiberoptic, and laser technologies continue to expand, they hold promise of educating millions of adult students on and off campus. A distance education model's shape is determined by the particular needs of the region in which it is based. The distance education projects that have made a real impact in the United States have usually been multimedia networks, often employing high-frequency microwave technology. The technology that has allowed all of this to occur falls under the umbrella of networking. Model microwave networks include the closed circuit television networks operated by the Association for Higher Education of North Texas, the Indiana Higher Education Telecommunication System, the Kirkwood (Iowa) Telecommunication System, the South Carolina Educational Television Network, and the Central Maine Interactive Telecommunications System and Aroostook County Telecommunications System. All these models demonstrate that colleges, universities, and consortia can extend undergraduate, graduate, professional, and continuing education via telecommunication to adults at times and places that suit their convenience. (YLB)

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SUNRISE TO SUNSET LIFELONG LEARNING
VIA MICROWAVE NETWORKS:
FROM A NATIONAL HERITAGE

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Sunrise to Sunset Lifelong Learning Via Microwave
Networks: From a National Heritage

Up to and beyond the turn of the century, the Green Chair Group (1982) has predicted the increased breadth and complexity of distance education as a result of the acceleration of life expectancy and the frequency of career and job changes. The age of the distance learners will range from 18 to 70, with a slant toward the higher end of the spectrum as life expectancy rises throughout the next century (American Council on Education, 1985). As midlife career changes become the norm rather than the exception, distance learners will want more occupational and job-related programs. The largest proportion will be enrolled, in fact, because they believe that education is the path to a richer life (Lambert, 1983). Greater longevity will also bring with it more demand for informal courses and short courses in leisure-time and cultural activities (Perry, 1978). Of necessity, adult educators will be turning to technological delivery forms to meet the insistent call for increasing programs.

The years since the creation of the first university radio station in 1917 have revealed an incredible growth in the field of educational telecommunication. To appreciate the potential contribution of technology to contemporary distance education, adult educators must have some notion of the media distribution methods now available for delivering instruction and supporting students as they study. In the interest of mutual understanding, the following definitions are tendered:

Open-Circuit TV--TV transmission where broadcasting is radiated for reception by the general public on standard TV receivers.

Closed-Circuit TV--TV transmission where distribution is accomplished via microwave or coaxial cable technologies to specific TV receivers rather than to the general public.

VHF--Very High Frequency, the frequencies used for TV broadcasting between channels 2 through 13.

UHF--Ultra High Frequency, the frequencies used for TV broadcasting between channels 14 through 83.

Microwave Distribution--High frequency directional transmissions above the UHF spectrum (close to and higher than 1 GHz) for carrying audio, video, and data signals from point to point in one direction for a distance of up to 50 miles.

ITFS--Instructional Television Fixed Service, a series of four-channel groupings for short-distance (up to about 25 miles) TV transmission which have been primarily set aside for nonprofit educational usage. These signals are considered in the lower portion of the microwave spectrum, and ITFS transmissions cannot be received on a standard TV unless a special downconverter is used.

Satellite--An "antenna in space" that receives, amplifies, and retransmits signals to relay audio, video, or data to receiving stations on earth. The important communication feature of the satellite is its transponder, or receiver-retransmitter. Each of the satellite's 12 or 24 transponders is usually equated with a capacity of one television signal or 1,200 telephone calls.

Interactive Technologies--Those technologies that permit at least some form of two-way communication (voice, video, data, or a mix) between two or more individuals. In some cases, a combination of two or more technologies may be used to achieve interaction (e.g., open-circuit TV and the telephone).

Slow-scan TV--A telephone-based technology that captures still frame pictures and displays them on television sets. Unlike the full-motion video programming seen on TV sets at home, slow scan video updates the image only a few times every minute.

Telecourse--A noninteractive, fixed-format instructional television series offered for credit which examines and presents a body of knowledge through the use of sight, sound, color, and movement and which is accompanied by text books and study guides.

Moderated by a professor-host, those courses produced for national distribution have high visual interest, featuring filmed segments, animation, guest interviews, dramatic pieces, and other production devices.

Historically, the use of technology-based distance education has been predominantly via open-channel transmission utilizing either commercial or public broadcasting stations operating on UHF or VHF frequencies (Hilliard, 1985; Zigerell, 1984). One of the earliest and hardest of the pioneer open broadcast services for the distant learner was Chicago's TV College, established in 1956. A fully accredited program of the City College of Chicago, the TV College is believed to be the oldest extant remote-study program using educational technology as the basis for its course delivery system (Ely, 1981). Still on the air with a UHF station owned and operated by the community college system, the last official report (Zigerell & Chawsow, 1974) claimed more than 200,000 enrollments with some 500 students completing their associate of arts degree entirely by TV.

Returning education to the public broadcasting sector after years of only public affairs and cultural programming, the telecourse may stand as America's major contribution to the technology-based distance education movement (Wood & Wyle, 1977; Zigerell, 1984). Starting in 1975 with the first broadcast of The Ascent of Man over Public Broadcasting Service (PBS) stations nationwide, several series have been available for educational use. What made the series a unique educational experience was the development of a college-credit course based on the series by Coastline Community College, Miami-Dade Community College, and the University of

California Extension at San Diego (Rein, 1975). Supplemental print materials developed for the course were used by an estimated 40,000 students enrolled in 420 educational institutions throughout the United States (Chamberlain, 1976). As a result of this startling success, increasing numbers of new telecourses have been produced until now there are over 140 high quantity series in political science, psychology, English composition, literature, business, computer literacy, earth science, biology, humanities, and future studies. The most recent statistics indicate that in 1979, 750 colleges and universities aired 6,884 courses to 498,000 enrolled students (Dirr, 1985; Dirr, Katz, & Pedone, 1981).

A new partnership between public television and higher education was established in 1980 when PBS created an Adult Learning Programming Department (Grossman, 1982). In conjunction with local public broadcasting stations, the first national initiative to deliver adult learning materials became a reality via the satellite-based utility. Course offerings in the areas of informal learning, college credit, and professional development totaled more than 1,600 programs during the first broadcast year (A Report, 1982). After the Adult Learning Service's first two years of operation, 220 PBS stations had transmitted to some 130,000 students telecourses offered by over 600 participating colleges, and universities (Brock & Goldstein, 1985). Further, an average of 2.4 million television households have watched at least one of the programs on PBS every week, according to recent PBS news releases.

When specialized adult audiences have been targeted, electronic-based distance education has employed closed-circuit technologies, such as the Instructional Television Fixed Service band (Hart, 1985). Shortly after the first VHF and UHF educational stations came on the air, it became apparent that single-channel open-circuit broadcasting stations could not meet all of education's needs. After the simultaneous transmission of course material to multiple sites via low frequency microwave proved to be technically satisfactory, the Federal Communication Commission authorized ITFS broadcasts in 1963. Like all TV signals, ITFS impulses travel in a straight line and follow lines of sight; however, they cannot be received on conventional home receivers unless special receiving antenna and equipment are installed. In effect, ITFS is a private, closed-circuit transmission system operating on up to four-channels, using electronic signals transmitted through the ether instead of similar impulses sent by coaxial cable (Gordon, 1970).

More recently, high frequency microwave systems, costing between \$25,000 to \$50,000, have been employed to electronically link educational institutions, ITFS delivery networks, and remote learning centers over intermediate distances. Terrestrial microwave transmissions, which operate in the spectrum close to and above 1 GHz, are used to relay telecommunication signals on a point-to-point basis. The majority of the Bell interstate and transcontinental telephone system is carried by microwave from transmitter to transmitter, located at points from 25 to 50 miles from one another. Prior to the development of satellite

communication, microwave transmission represented the only reliable form of intercity and coast-to-coast communication (Singleton, 1983).

A distance education model's shape is determined by the particular needs of the region in which it is based (Perraton, 1982). The distance education projects that have made a real impact in the United States have usually been multimedia networks (Zigerell, 1984), often employing high-frequency microwave technology. The technology that has allowed all of this to occur falls under the umbrella of networking. Networking can be defined as the ability to (a) exchange information between users or (b) share the resources involved in this process. A network consists of two or more information sources or destinations (people, computers, TV systems, or other electronic devices) linked via communication media (coaxial cables, telephone lines, microwave, or satellite links) for the purposes of information exchange or resource sharing (Barden & Golden, 1986).

One of the oldest and largest higher education closed-circuit television networks is operated by the 17 members of the Association for Higher Education of North Texas (AHE). AHE was incorporated in 1980 through a merger of The Association for Graduate Education and Research in North Texas (TAGER) and the Interuniversity Council. The TAGER Television Network, founded in 1967, serves as an interactive telecommunications utility for the business and higher educational community in the Dallas-Fort Worth area by offering credit and noncredit courses to corporate employees at work sites and learners at campuses who receive televised courses from other member campuses (Association of Higher Education of

North Texas, n.d.). Of the TAGER course offerings, 90 percent are credit bearing, and 85 percent are graduate level in engineering, business or computer science. Although 90 percent of the courses are live and interactive, TAGER does offer some prerecorded short courses on a variety of technical and management topics. In the 1983-84 academic year, over 2,200 students took credit courses and over 120 took noncredit courses (Buson, 1985).

The TAGER network is distributing live and videotaped television courses via four ITFS channels, point-to-point high frequency microwave links, and local cable companies. Most programming is originated as one-way video and two-way audio, but certain courses have used two-way video. The two-way audio communication can occur either by microwave, dedicated telephone line, or both. With some exceptions, most of the colleges are connected to the TAGER network switching center via point-to-point microwave channels, and most corporate facilities are linked via ITFS. Cable companies that serve 26 suburban communities and over 100,000 homes are interconnected to the network. In this closed-circuit, multi-channel network, courses are originated in a production studio or teleclassroom at the offering institution and are directed by the TAGER switching center to classrooms off campus or to other campuses equipped to receive the microwave signal (Tucker, 1983).

In addition to TAGER, the Indiana Higher Education Telecommunication System (IHETS) is recognized as being one of the most comprehensive telecommunications systems in this country for distance education (Lewis,

1983). Created in 1967 by the Indiana legislature, IHETS has evolved into a multi-purpose, multi-media, closed-circuit, statewide telecommunication delivery system that interconnects a wide range of educational centers and postsecondary institutions for purposes of improving instruction, administration, interinstitutional cooperation, and networking among educators. Graduate and professional continuing education programming have included medicine, dentistry, nursing, pharmacy, engineering, speech and audiology, education, agriculture, and finance. The Indiana University School of Medicine has the distinction of being the largest single user of the system, utilizing about 40 hours per week of programming for interactive continuing medical education and teleconferences as well as prerecorded single concept videotapes. Course material has originated primarily from five Indiana sites: Purdue University, West Lafayette; Indiana University, Bloomington; Indiana State, Terre Haute; Ball State, Muncie; and several organizations in Indianapolis. In any one year the IHETS system has reached between 12,000 and 13,000 students with credit and noncredit courses (Gruebel, 1983).

IHETS has connected more than 45 educational institutions with a point-to-point microwave network. In conjunction with the microwave network, the system has operated a very large ITFS program with 32 channels reaching more than 100 off-campus locations, such as adult learning centers, hospitals, industries, businesses, and public television broadcast stations. A specially designed audio talk back system called Teleresponse has made interactive (one-way video, two-way audio) transmission possible

between teacher and student. On the microwave network, two-way video interaction has been used for courses created and taught jointly by two or more institutions. The entire network is controlled by a central computer capable of switching programming to and from different locations (Danna, 1986).

Kirkwood Community College, a recognized leader in the field of electronic distance education, has also used point-to-point microwave for interactive video instruction combined with an ITFS system (Gruebel, 1983). The Kirkwood Telecommunication System (KTS) has extended educational opportunities to individuals throughout a seven-county service district in Iowa offering lower-division liberal arts and vocational-technical courses, as well as professional continuing education and general-interest programming. Liberal arts courses have included a wide range of humanities, social science, and science subjects. Nursing, business, and agriculture have been involved in the vocational-technical curriculum, and the continuing education program has served professionals in the fields of nursing, agriculture, and energy. In the 1981-82 academic year, enrollments were reported to be approximately 2,000 students (Tate & Kressel, 1983).

KTS is composed of four totally interactive microwave links, four interactive ITFS channels (one-way video and two-way audio), and four channels of cable television on the Cedar Rapids Cable Network as well as a 36 channel on-campus closed-circuit distribution system and a public broadcast FM station. KTS has used a Telelink Network for point-to-point

microwave control. Telelink has permitted two-way video and two-way audio transmission between the campus and the four remote learning centers. One unique aspect of the Telelink system is the option of changing the configuration of the network from two to five sites. If there is a need to offer a course only to one distant center, the system can be configured to accommodate this need and may still offer another course at the same time to other locations. This feature also is useful when an instructor teaching to several locations wishes to form small-group discussion sessions between specific learning centers. The system can be reconfigured during this period, and then all sites may be brought together at an appointed time (Bunson, 1985).

Since 1969, the colleges of Engineering and Business Administration at the University of South Carolina (USC) have been offering interactive courses over the South Carolina Educational Television Network (S.C.ETV) closed-circuit microwave system leased from the telephone company. Adult students may complete a master's degree in these two disciplines entirely from the network's curriculum. Approximately 80 percent of the educational programming offered statewide by S.C.ETV is graduate and continuing education. Other courses extended have included lower-division and upper-division undergraduate social science, science, humanities, and education; and graduate pharmacy, social work, librarianship, and education. Public school teachers have constituted a large block of the continuing education clientele (40 percent), in part because they are required by the state to acquire six graduate credit hours every five years in order to renew their

teaching certificates. The overall enrollment in the 1980-81 academic year was approximately 3,300 students (Lewis, 1983).

In addition to the regular open-circuit public broadcasting service, S.C.ETV is operating a statewide, interactive, closed-circuit television network that utilizes telephone company microwave and coaxial cable facilities to transmit programs from the ETV Center in Columbia to over 400 schools, hospital, police departments, technical colleges, and two-year and four-year campuses of the USC system. For the purpose of continuing education, most programming is distributed to the nine USC campuses and ten technical colleges and higher education centers capable of providing one-way video and two-way audio facilities. Due to rising lease costs reaching almost \$4 million, S.C.ETV is planning to replace the network with 11 high-powered, 50-watt ITFS transmitters, six lower-powered ITFS repeaters, and 14 10-watt transmitters. The system will provide four channels of programming to 405 locations throughout the state and will have the potential to add learning centers for only the low cost of reception equipment (\$600 to \$4,000 depending on the distance). Programs will originate in Columbia and will be fed into the ITFS system via a four-channel, state-owned microwave network (Hopkins, 1983).

Employing both point-to-point full-motion microwave and slow-scan television, the purpose of the Central Main Interactive Telecommunications System (CMITS) and Aroostook County Telecommunications System (ACTS) has been to use interactive video technology to cost effectively serve the continuing educational needs of practicing medical professionals at health

facilities in two rural regions of Maine. By combining expertise available at the seven member organizations of CMITS (five hospitals, a family practice residency program, and the University of Maine at Augusta) and the five member organization of ACT (five hospitals), the consortium is able cooperatively to develop educational programs. Most of the CMITS and ACT programming has been noncredit professional continuing education that is planned, produced, implemented, and evaluated by user groups made up of members of specific professions or content specialities at one or more sites. Participants have included nurses, medical records staff, medical technologists, directors of social work, and critical care staff. Two to four credit courses have been offered each semester by the University of Maine at Augusta occupying about 10 percent of the system's time. Credit courses have involved subjects such as clinical pharmacology, anatomy and physiology, nutrition, methods of applied mathematics, and communication psychology. Approximately 200 professionals were enrolled in credit courses on the CMITS network in the 1980-81 academic year, and the total audience for all offerings had reached 15,000 attendees. This latter figure included many duplications, since participation by one individual in numerous sessions was very common (Lewis, 1983).

CMITS is using point-to-point microwave to provide two-way video and two-way audio educational programming. All transmission signals converge in Augusta, where they are distributed to the participating sites. All seven participating sites are similarly equipped, so that programs can be initiated from any of them. Up to three two-way television sessions may

take place simultaneously, and a single session may include all sites. During the summer of 1981, ACTS began operation of a slow-scan television system utilized by five hospitals in Aroostook County over 300 miles to the north of the area served by CMITS. Use of this technology allowed the Aroostook organizations to communicate among themselves and with CMITS sites. Employing this slow-scan technology, the ACTS organizations are able to convert moving images into a series of still pictures and then transmit the visual material via inexpensive telephone lines. This is currently the only known example of an interface between broadband two-way video and slow-scan video technology for educational purposes (Lewis, 1983).

What is impressive about these models is that they demonstrate colleges, universities, and consortia can extend undergraduate, graduate, professional, and continuing distance education via telecommunication to adults at times and places that suit their convenience. Telecommunication technologies are now available to institutions at prices they can afford to deliver sound instruction over intermediate as well as short and long distances. At the same time, the technologies can be made interactive and allow distance learners to interact with instructors and fellow students as if they were actually sitting in the classroom. The ease with which modern communications technologies can link educational institutions to homes, work sites, and community centers has made adult education and lifelong learning opportunities increasingly more accessible to individuals in our society.

More and more adult education is being transformed by electronic technology at the local, regional, and national level. As teleconferencing, television, microwave, minicomputer, satellite, fiberoptic, and laser technologies continue to expand, they hold promise of educating millions of adult students on and off campus. The telecommunication field appears, at last, on the verge of fulfilling the great hopes of the 1940's that each home could be a university center as long as it had a working television set and a willing learner. The technology exists and is becoming less expensive yearly; deliver systems are being built; courses, some carefully designed and well-produced, are available, and more are on the way from a variety of sources. The educational needs of adult learners in this nation are great, and the partnership of electronic technology and distance education is now poised to offer sunrise to sunset lifelong learning.

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